

Assessment of Attack Reconnaissance Helicopter (ARH) Machining, Cutting and Drilling Operations

Project Number #NP005006909
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Task Order 004 – Final Report

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Bell Helicopter
Fort Worth, TX.

Submitted by
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14. ABSTRACT The new Bell Attack Reconnaissance Helicopter (ARH) was developed to meet the Army's need for a fast, agile armed reconnaissance helicopter. Based on the success of this war fighting machine, the Army has proposed an effort to assess the ARH machining, cutting, drilling, and related operations in support of the Aviation and Missile Research Development and Engineering Center (AMRDEC) Manufacturing Science and Technology (MTS) Division as it supports the AMRDEC Aviation System Integration Facility (Comanche Solution/ARH funded) effort.					
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In Support of Task Order 004

Assessment of Attack Reconnaissance Helicopter (ARH)

Machining, Cutting and Drilling Operations

Prepared by: Doug Perillo

Executive Summary

The new Bell Attack Reconnaissance Helicopter (ARH) was developed to meet the Army's need for a fast, agile armed reconnaissance helicopter, see Figure #1 and Figure #2. A combat-modified version of Bell's best-selling commercial 407 helicopter, the ARH is powered by a proven and reliable engine platform that provides optimum performance, maneuverability, and confidence for an array of missions.

The Bell ARH thrives even in the most adverse conditions. It has high ballistic tolerance and crashworthiness, and can be equipped with the latest Aircraft Survivability Equipment. Bell-built in Texas, the ARH is C-130 rapid deployable, fully shipboard compatible, and is supported by the Bell network virtually anywhere it lands around the world.

Based on the success of this war fighting machine, the Army has proposed an effort to assess the ARH machining, cutting, drilling, and related operations in support of the Aviation and Missile Research Development and Engineering Center (AMRDEC) Manufacturing Science and Technology (MTS) Division as it supports the AMRDEC Aviation System Integration Facility (Comanche Solution/ARH funded) effort. Task 004 supports the basic IDIQ contract task "New Project Implementation."



Figure #1, Bell ARH Front View



Figure #2, Bell ARH Side View

Scope

The NCDMM assembled a team of qualified engineers (familiar with machining, cutting, drilling, and related manufacturing operations) and traveled to the ARH prime manufacturing locations, Bell Transmission Manufacturing Facility located in Fort Worth, TX and the Bell Composite Manufacturing Facility located in Hurst, TX. During each visit, a presentation was given by the NCDMM personnel followed by a project discussion and a facility tour. During the discussion and tour, it was the intention of the NCDMM to locate problem areas, such as manufacturing and/or processing issues that the NCDMM could assist Bell in a solution.

Bell - Transmission Manufacturing Facility Site Visit, Fort Worth, TX

On June 20, 2006, personnel from the NCDMM visited the Bell Transmission Manufacturing Facility located in Fort Worth, TX. See Appendix “A” for a complete attendee list.

Jim Corwin from James Corwin Associates Inc. was contracted by the NCDMM to lead in the trip development along with providing engineering support to the NCDMM. Mr. Corwin started the meeting with an introduction of all parties along with a brief description and reason for the visit. Following Mr. Corwin, the NCDMM engineers gave a slide presentation of related projects followed by a question and answer session between the NCDMM and Bell engineers.

The meeting lasted roughly one (1) hour, after which Wayne Scott, Chief Manufacturing Engineer, provided the NCDMM with a tour of the facility. The tour covered the entire facility with emphasis put on processes that Mr. Scott felt were problem areas. This report is in conjunction with a trip summary provided by Jim Corwin of James Corwin Associates Inc. See the Bell – Transmission Manufacturing Facility Trip Report in Appendix “B”.

The first issue noticed by the NCDMM engineers was a process where Bell is threading many holes in a large transmission housing. This is performed first by drilling all the holes and secondly, power tapping the holes. A possible time saving solution presented by the NCDMM would be to implement a single tool to drill, chamfer, and thread mill each hole in a single pass.

The second problem area shown to the NCDMM engineers was a steel ring approximately twelve (12) inches in diameter. Around the ring were thirty

(30) threaded holes. The problem issues were poor tool life and the threading process resulted in a burr pushing up where the threaded hole meets the seal surface. This burr results in additional timely operations to remove. The NCDMM recommends an assessment of the current tooling and process. This could be followed by a Design of Experiment (D.O.E) to determine the best tool geometry and/or tool coating to improve tool life and reduce or eliminate burring.

A third problem area shown to the NCDMM engineers was the removal of the burr around the transmission gear teeth. This is currently a manual process done by hand. This is a highly skilled, tedious work area. As older employees are retiring, Bell is having difficulties filling this critical position. Bell has ordered a specialized robotic machine to perform this task. The NCDMM engineers have determined that Bell has already taken the appropriate steps to improve this task. Therefore the NCDMM could add value to the process possibly after the implementation of the new machine.

Another area of concern was fixturing. Bell uses several ball lock fixturing methods. The NCDMM recommended that Bell research the use of Zero Point locking methods. Zero Point locks are much more accurate and quicker to change over.

Mr. Scott had mentioned that Bell recently purchased a large Vertical Turning Lathe (VTL) with live tooling. This is the first live tooling lathe that Bell has implemented in their facility. Mr. Scott mentioned that Bell might need recommendations on tooling for this new machine. The NCDMM stressed that they would be able to assist Bell with the selection of these tools.

The assessment at the transmission plant went very well. Several areas the NCDMM could provide a possible cost savings solution were located, with follow up information provided by Bell.

During the visit, several Bell personnel inquired about composite machining. It was recommended that the NCDMM visit the Bell composite Manufacturing Facility located in Hurst, TX. The NCDMM worked through Jim Corwin to arrange this trip.

Bell - Composite Manufacturing Facility Site Visit, Hurst, TX

On August 31, 2006, personnel from the NCDMM visited the Bell Composite Manufacturing Facility located in Hurst, TX. See Appendix “C” for a complete attendee list.

Again, Jim Corwin from James Corwin Associates Inc. was contracted to lead in the trip development along with providing engineering support to the NCDMM. This report is in conjunction with a trip summary provided by Jim Corwin of James Corwin Associates Inc. See the Bell – Composite Manufacturing Facility Trip Report in Appendix “D”. Mr. Corwin started the meeting with an introduction of all parties along with a brief description and reason for the visit. He also provided a brief overview of the previous Bell – Transmission Manufacturing Facility visit in Fort Worth, TX. Following Mr. Corwin, the NCDMM engineers gave a slide presentation of related projects followed by a question and answer session between the NCDMM and Bell engineers.

Peter Cockburn, Cutting Tool Specialist at Bell, mentioned the threaded ring issue, which was brought up during the Bell – Transmission Manufacturing

Facility visit in Fort Worth, TX. Mr. Cockburn had several ideas to correct the issue and appeared very interested in pursuing this as an NCDMM project.

After the meeting, Ron Turner, Sr. Process Engineering Specialist at Bell, led the tour through the composite facility. During the tour there were many areas that the NCDMM determined could provide possible cost savings solutions. However, there was only one major issue that the Bell engineers needed a concentrated effort. That issue was the milling and drilling of large, deep holes in a composite pendulum yoke for the V-22 Osprey. The V-22 Osprey tiltrotor is a revolutionary, vertical and short take-off and land (V/STOL), multi-purpose aircraft with excellent high-speed cruise performance. This advanced technology rotorcraft performs a wide range of V/STOL missions as effectively as a conventional helicopter; while equally capable of achieving the long-range cruise efficiencies of a twin turboprop aircraft, see Figure #3. The holes on the pendulum yoke average 1.5” round by 2.0” deep. The current method is to drill from each side with a diamond abrasive hole saw. The reason for drilling from each side is to reduce the chance of composite delamination during tool breakout. This is a temporary fix; it required the use of a special fixture to flip the part to allow access from both sides. It also required a milling operation to finish the hole to size. This improvement has shown to produce good holes but has added costly steps to the complete process. The NCDMM could develop a cutting tool that would allow finishing of the hole from one side, with one tool. This would eliminate the need for flipping the part, therefore eliminating the need for the special fixture. It would also reduce the cycle time and the number of

tools. As discussed with Bell, this may develop into a future project between Bell and the NCDMM.



Figure #3, Bell V-22 Osprey

Conclusion

During the visit to Bell – Transmission Manufacturing Facility, Fort Worth, TX, several problem issues were discussed. Each issue was listed in a trip summary, which was sent to all who attended the meeting. The NCDMM engineers asked that Bell personnel prioritize the list and, from that, a project would be selected. The NCDMM received no response from Bell.

During the visit to Bell – Composite Manufacturing Facility, Hurst, TX, a few problem issues were discussed. The NCDMM engineers stressed the benefit of having a third party evaluation along with the ability to develop new processes offline. Ron Turner, Sr. Process Engineering Specialist contacted the NCDMM following the visit; he determined that the pendulum yoke for the V-22 would be an issue that Bell would want the NCDMM to proceed with. Currently, Bell and the NCDMM are determining a way to fund the effort.

The Task Order efforts identified multiple opportunities for engagement and a stronger relationship between Bell and the NCDMM resulted from the two trips. It is the feeling that Bell further understands the mission of the NCDMM and would likely use the services of the NCDMM in the near future.

Appendix “A”

Bell Meeting Attendee List Transmission Manufacturing Facility Fort Worth, TX

Trip Date: June 20, 2006

Name	Organization	Email
Jim Corwin <i>Consultant</i>	JCAI/Army	corwinj@att.net
Cindy Fenny <i>Process Engineer</i>	Bell / Process Engineering	cfenny@bellhelicopter.textrom.com
Max Trull <i>Process Engineer</i>	Bell / Process Engineering	MTrull@bellhelicopter.textron.com
Joe Slusarczyk <i>Project Engineer</i>	NCDMM	Joe.Slusarczyk@ncdmm.org
Ron Turner <i>Process Engineer</i>	Bell / Process Engineering	rdturner@bellhelicopter.textron.com
Chris Mueninghoff <i>Process Engineer</i>	Bell / Programming	cmueninghoff@bellhelicopter.textron.com
Wayne Scott <i>Chief Manuf. Engineer</i>	Bell / Process Engineering	wscott@bellhelicopter.textron.com
Doug Perillo <i>Project Engineer</i>	NCDMM	Doug.Perillo@ncdmm.org

Appendix “B”

Trip Report Provided by Jim Corwin Bell – Transmission Manufacturing Facility Fort Worth, TX

**James Corwin
Associates Inc.**

To: Doug Perillo;
From: Jim Corwin
CC: Joe Slusarczyk
Date: 7/3/06
Re: Trip to Bell Helicopter Transmission Manufacturing Facility 6/20/06

Subject: Trip Summary

Discussion: The purpose of the trip was to provide engineering support to NCDMM personnel Doug Perillo and Joe Slusarczyk as they visited the Bell transmission plant. They hoped to be able to identify issues that exist in the current manufacturing processes where they could improve and reduce the cost of the operation. The tour hosted by Wayne Scott Process Engineering Department, Head of Capital Expansion started in the Bell conference where Doug Perillo briefed a group of Bell engineering and manufacturing personnel.

Meeting Attendees:

Wayne Scott	Process Eng	817-280-4013	wscott@bellhelicopter.textron.com
Cindy Fenny	Process Eng	817-280-2549	cfenny@bellhelicopter.textron.com
Max Trull	Process Eng	817-280-2678	mtrull@bellhelicopter.textron.com
Ron Turner	Process Eng	817-280-8268	rturner@bellhelicopter.textron.com
Chris Mueninghoff	Process Eng	817-280-5851	cmueninghoff@bellhelicopter.textron.com
Joe Slusarczyk	NCDMM	724-539-6843	joeslusarczyk@ncdmm.org
Doug Perillo	NCDMM	724-539-5901	dougperillo@ncdmm.org
Jim Corwin	JCAI	314-616-2103	corwinj@att.net

Doug Perillo provided an overview of the NCDMM program and discussed several success stories associated with projects at other plants. Bell personnel were very interested in the success stories and asked several questions. Doug and Joe were able to answer all of the bell questions satisfactorily, and provided additional information through brochures containing more success story details and web contact information.

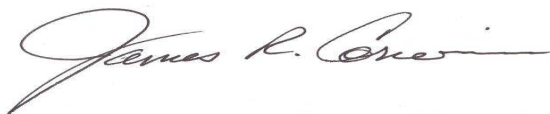
After the briefing Wayne Scott led a tour through the facility. The tour lasted almost three hours and Doug and Joe identified several areas where they can possibly provide improvement to existing machining operations. A partial listing of these areas was provided to Bell Helicopter, Wayne Scott and they are reproduced below as well as a description of how the NCDMM process works

1. Many holes on transmission casing, all holes are currently drilled & taped.

- a. Develop process and select proper tooling to drill, counter sink and thread mill in single pass.
2. Ring with 30 3/8 24 thread milled holes, poor tool life and burr pushing up from top of hole.
 - a. Develop process and selection of tooling to drill, counter sink and thread mill in single pass.
 - b. Perform machining D.O.E. on selected tools with Bell supplied material. Determine champion tool.
3. Deburr of gear teeth currently done by hand. Bell spoke of recently researching/purchasing a robot to perform this task.
4. Deburr of lubrication holes in transmission casing. Blind intersecting holes.
 - a. Research methods of burr removal for intersecting holes. Involve Alliance Partner where needed.
5. Machine fixtureing, currently using several ball lock fixture locating systems
 - a. Develop and research of zero point fixtureing method
6. Recent purchase of VTL with live tooling and they are in the process of tooling up this machine.
7. Assist in the tooling selection
8. Primary materials at Bell are Pyroware x53 9310 steels, and Al 6061 & 7075.
9. Here is a rough example of how this would work.
 - a. We define the project
 - b. .Gather current process info. (Could require another trip for time study).
 - c. We process project. (When possible all testing and development will be done in NCDMM lab)
 - d. Train and/or implement at Bell.

NCDMM personnel indicated that they would like to visit the Bell composites manufacturing plant located in Hearst Texas. I am sure that this can be arranged at a later date.

Respectfully Submitted



President James Corwin Associates Inc

Appendix “C”

Bell Meeting Attendee List Composite Manufacturing Facility Hurst, TX

Trip Date: August 31, 2006

Name	Organization	Email
Jim Corwin <i>Consultant</i>	JCAI/Army	corwinj@att.net
Joe Slusarczyk <i>Project Engineer</i>	NCDMM	Joe.Slusarczyk@ncdmm.org
Doug Perillo <i>Project Engineer</i>	NCDMM	Doug.Perillo@ncdmm.org
T. Phil Autry <i>Production Engineer</i>	Bell	tautry@bellhelicopter.textron.com
Ron Turner <i>Sr. Process Engineering Specialist</i>	Bell / Process Engineering	rturner@bellhelicopter.textron.com
Steven Cordell <i>Production Engineer</i>	Bell	scordell@bellhelicopter.textron.com
Ron Tovar <i>Production Engineer</i>	Bell	rtovar@bellhelicopter.textron.com
Peter Cockburn <i>Cutting Tool Specialist</i>	Bell	pcockburn@bellhelicopter.com
Jim Brown <i>Process Engineer</i>	Bell	jdbrown@bellhelicopter.com
Glenn Sheffler <i>Manager, Business Dev.</i>	NCDMM	Glenn.sheffler@ncdmm.org

Appendix “D”

Trip Report Provided by Jim Corwin Bell – Composite Manufacturing Facility Hurst, TX

**James Corwin
Associates Inc.**

To: Doug Perillo;
From: Jim Corwin
CC: Joe Slusarczyk
Date: 9/13/06
Re: Trip to Bell Helicopter Composite Manufacturing Facility 8/30/06

Subject: Trip Summary

Discussion: The purpose of the trip was to provide engineering support to NCDMM personnel Doug Perillo Joe Slusarczyk and Glenn Scheffler as they visited the Bell composites manufacturing plant. They hoped to be able to identify issues that exist in the current manufacturing processes where they could improve and reduce the cost of the operation. The tour hosted by Ronnie Turner Process Engineering Department, Senior Process Engineering Specialist where Glenn Scheffler briefed a group of Bell engineering and manufacturing personnel on NCDMM activities and related “Success Stories”

Meeting Attendees:

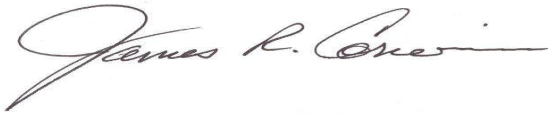
Ron Turner	Process Eng	817-280-8268	rturner@bellhelicopter.textron.com
T. Phil Autry	Production Eng		tautry@bellhelicopter.textron.com
Steven Cordell	Production Eng		scordell@bellhelicopter.textron.com
Ron Tovar	Production Eng	817-280-6185	rtovar@bellhelicopter.textron.com
Peter Cockburn	Cutting Tool Eng	817-280-8072	pcockburn@bellhelicopter.textron.com
Jim Brown	Process Eng	817-280-1502	jdbrown2@bellhelicopter.textron.com
Glenn Scheffler	NCDMM		glenn.scheffler@ncdmm.org
Joe Slusarczyk	NCDMM	724-539-6843	joeslusarczyk@ncdmm.org
Doug Perillo	NCDMM	724-539-5901	dougperillo@ncdmm.org
Jim Corwin	JCAI	314-616-2103	corwinj@att.net

Glenn Scheffler provided an overview of the NCDMM program and discussed several success stories associated with projects at other plants. Bell personnel were very interested in the success stories and asked several questions. Glenn, Doug and Joe were able to answer all of the bell questions satisfactorily, and provided additional information through brochures containing more success story details and web contact information.

After the briefing Ronnie Turner and Ron Tovar led a tour through the facility. The tour lasted almost two hours and Doug and Joe reviewed several of the composite machining operations as well as several of the thick section composites where they can possibly provide improvement to existing machining operations. A partial listing of these areas will be provided to Bell Helicopter, Ronnie Turner.

NCDMM personnel invited the Bell Engineers to the NCDMM facility and several indicated that they will accept the invitation.

Respectfully Submitted

A handwritten signature in cursive script, reading "James R. Corwin". The signature is written in dark ink and is positioned above the printed name.

President James Corwin Associates Inc

Appendix “E”

Acknowledgements

Figure #1, Bell ARH Front View, www.bellhelicopter.textron.com

Figure #2, Bell ARH Side View, www.bellhelicopter.textron.com

Figure #3, Bell V-22 Osprey, www.bellhelicopter.textron.com